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ORIGINAL PAPER

Openness and income disparities: does trade explain the "Mezzogiorno effect"?

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Abstract We use Italian regional data to answer the question whether trade affects within-country income differentials. In Italy, the more affluent Northern regions trade more with the rest of the world than the poorer ones in the Southern "Mezzogiorno" regions. Prima facie, there is a positive correlation between external trade and per capita income. Studying this relationship empirically requires taking into account the endogenous component of trade. We argue that panel co-integration models can complement instrumental variables techniques to account for the endogeneity of trade in a panel context. Both methods show a positive link between trade openness and the level of income per capita.

Keywords Openness · Growth · Regional income disparities · Panel cointegration · Italy

JEL classification F2 · F43

1 Motivation

There is a growing concern that the increasing integration of the world economy could lead to increased income disparities. International integration may lead to income disparities across different skill groups and across different countries. But does increased openness also affect regional income differentials within a given country? Stylized facts for Italian regions suggest that it perhaps does. Both, GDP

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per capita and trade openness in Southern Italy have been persistently below comparable values for the Centre-North.[1] In this paper, we analyze whether a low degree of de facto trade openness at the regional level can account for the "Mezzogiorno effect".

Whether trade causes growth—or rather the reverse—has been a long disputed topic in international economics, in particular in relationship with trade policy choices and thus de jure openness (see, e.g., Baldwin 2003; Rodriguez 2006). Instead, our paper is in the tradition of literature that examines the link between de facto openness and income. From a theoretical point of view, improved utilization of scarce resources, improvements in technologies, and the exploitation of economies of scale can explain a causal effect of trade on growth (Helpman 2004). In principle, the link between trade and the level of income at the regional level should not differ much from the link at the national level. Yet, estimating the relationship is problematic since growth and trade are endogenously determined: more trade might spur growth, but regions whose incomes are high for reasons unrelated to trade might also trade more. Many previous studies based on cross-country data use instrumental variables (IV) to account for the endogeneity of trade. Frankel and Romer (1999) propose accounting for the endogeneity of actual trade volumes using the time-invariant geographical component of trade. Applying this modeling strategy in a panel context requires time-varying instruments such as foreign GDP.

Our empirical approach differs from earlier studies in two main regards. First, we argue that cointegration models, which account for the endogeneity of trade, are a useful tool for analyzing the openness—growth nexus in a panel context. Using different panel cointegration tests and estimates of the cointegration parameters, we find evidence for a positive impact of trade on regional GDP per capita which is qualitatively similar to those from the IV estimates.

Second, while panel cointegration models can be readily applied also to a cross-country setting, our use of regional data has further advantages because differences in institutions are less pronounced within than between countries. Hence, we address the concern that differences in institutions across countries might affect both, per capita income and trade. A further advantage of regional data is that differences in convergence rates between regions of the same country are likely to be smaller than those between countries. This addresses the point made by Felbermayr (2005) that the model of Frankel and Romer (1999) might be mis-specified because of its implicit assumption that countries are in their respective steady state.

The paper is organized as follows. Section 2 presents stylized facts on openness and on the macroeconomic convergence for Italian regions. Section 3 gives our results concerning the openness—and growth nexus using standard IV estimates. In a first step, an openness equation is estimated showing that geography has a significant impact on trade openness. Even controlling for geography, the Southern

[1] Trade openness is measured through the actual volume of foreign trade, which differs across Italian regions even though trade policy is the same across regions. See Table 1, Figs. 1 and 2 and the Appendix for the definition Centre-North and South.

Italian regions are significantly less integrated internationally than the regions in the Centre-North. In a second step, the estimated openness equation is used to generate predicted values for trade that serve as IV for actual trade in the growth equation. Results indicate that there is a positive link between trade openness and GDP per capita. Section 4 presents the results of panel cointegration techniques which account for common trends and address the endogeneity problem as well. We support our qualitative results using IV estimates and even find similar coefficient estimates. Section 5 concludes.

2 Stylized facts

This section shows that the richest Italian regions in terms of per capita income also show the highest levels of openness. This holds for different measures of openness such as trade in goods, foreign direct investment (FDI), or migration. Prima facie, this suggests a positive relationship between openness and per capita income.

2.1 Foreign trade

Table 1 gives trade shares by Italian region. On average, over the 1991–2005 period, Southern Italy's trade share was 16%, while Centre-Northern Italy's share stood at 46%. The 'gap' in trade performance between the South and the Centre-North has persisted over time.

The structure of trade across industries in the Centre-North and the South has not changed much. The South represents on average 10% of Italy's total external trade, showing a marked export specialization in petroleum products and transport equipment. Imports of raw materials, in particular oil, dominate the import structure in the South. The most relevant sectors in Centre-Northern exports are mechanical machinery and transport equipment, but also metals and metal products, chemical products, and textile and clothing. Exports of products in which Italy records revealed international comparative advantages tend to concentrate in Centre-Northern regions.

Table 1 and Fig. 1 show that Centre-Northern Italy's higher trade share is a rather widespread phenomenon, although far from being uniform. Two regions, Lombardy and Veneto, tend to drive the better performance in total trade openness of the Centre-North versus the South. In the case of Lombardy, this reflects the localization of many importers of national relevance. In the South, Calabria is an outlier, with a trade share close to only 3%, while Abruzzo, Sardegna, and Sicily have recorded trade shares close to those of the average performers of the Centre-North in recent years. In the case of Sardegna and Sicily, this is partly due to the fact that Italy's oil refinery industry clusters in these two regions.

2.2 Foreign direct investment

Northern and Southern Italy differ also in terms of factor endowments. Over the period 1991–2005, the average capital stock per capita in the South has been 85% of

Table 1 Trade in goods relative to regional GDP (%)

	1991–2005		1991	1995	2000	2005	1991–2005		1991	1995	2000	2005
	Trade/GDP						Exports/GDP					
	SD	Mean					SD	Mean				
Piemonte	*6.4*	*48.1*	41.6	56.5	51.9	48.2	*4.2*	*28.0*	23.1	33.2	29.9	27.8
Valle d'Aosta	*4.6*	*18.5*	10.3	24.6	24.1	21.4	*2.7*	*10.3*	4.8	14.7	12.8	13.5
Lombardia	*7.5*	*62.6*	49.5	65.4	71.5	71.4	*3.1*	*28.4*	21.7	31.3	31.0	31.0
Trentino-Alto Adige	*3.0*	*30.7*	25.3	33.8	33.3	33.7	*1.9*	*16.9*	11.6	18.9	17.1	17.4
Veneto	*8.2*	*53.3*	37.4	54.9	61.3	59.9	*4.8*	*30.5*	20.5	31.8	34.8	33.2
Friuli-Venezia Giulia	*6.3*	*42.3*	31.5	43.5	50.9	45.7	*4.4*	*28.1*	19.1	29.0	33.1	29.6
Liguria	*3.4*	*24.3*	19.6	24.5	27.0	30.3	*1.1*	*9.8*	8.0	11.2	9.9	10.2
Emilia-Romagna	*6.2*	*41.2*	30.4	41.9	46.0	50.0	*4.1*	*26.1*	18.0	26.9	29.1	31.2
Toscana	*5.5*	*40.5*	29.5	43.5	48.1	42.1	*3.1*	*23.6*	17.1	25.8	27.2	23.7
Umbria	*4.4*	*21.2*	13.3	23.0	24.7	26.8	*2.5*	*12.3*	7.4	14.1	14.1	14.7
Marche	*6.2*	*32.7*	21.5	33.4	36.9	40.7	*4.3*	*23.0*	14.2	24.0	25.1	26.9
Lazio	*2.9*	*22.7*	20.7	20.5	28.4	24.1	*1.2*	*7.7*	5.7	7.1	10.1	7.5
Abruzzo	*9.0*	*32.1*	17.7	33.9	41.4	39.0	*5.7*	*18.8*	9.9	19.9	23.3	24.6
Molise	*3.9*	*14.0*	5.7	14.7	16.3	16.3	*2.6*	*8.4*	2.8	9.3	9.7	10.3
Campania	*2.2*	*16.8*	12.9	17.1	20.1	17.4	*1.6*	*8.2*	5.1	8.5	10.2	8.3
Puglia	*2.3*	*17.4*	14.2	18.2	19.7	21.5	*1.5*	*9.4*	6.5	10.7	10.9	10.6
Basilicata	*6.0*	*13.4*	5.1	9.8	17.6	18.5	*5.0*	*9.3*	2.6	6.2	12.6	11.3
Calabria	*0.2*	*2.8*	2.7	2.5	3.0	3.1	*0.1*	*1.0*	0.8	0.9	1.2	1.0
Sicilia	*5.8*	*19.8*	13.5	17.1	28.7	31.2	*1.5*	*5.9*	4.5	5.2	8.1	8.7
Sardegna	*4.5*	*21.4*	18.2	20.3	27.8	32.9	*1.8*	*7.7*	5.8	7.0	9.8	12.4
Italy	*4.9*	*38.6*	30.2	40.1	44.5	44.2	*2.5*	*19.8*	14.6	21.3	22.3	21.8
South	*3.7*	*15.9*	11.5	14.7	19.8	23.9	*1.6*	*6.9*	4.4	6.6	8.5	9.8
Centre-North	*5.4*	*46.0*	36.5	48.3	52.5	51.0	*2.9*	*24.0*	18.0	26.0	26.8	25.7

Trade is defined as exports plus imports at current prices and exchange rates. GDP is at current prices

Source: ISTAT, own calculations

that in the Centre-North.[2] One would expect that these differences in the capital intensity of production trigger capital inflows into the South in the form of foreign direct investment. However, FDI has been quite concentrated in Northern Italian regions. According to balance of payments data for the years 1997–2005, FDI inflows and outflows relative to GDP have been persistently higher in the regions of the North and the Center. In cumulative terms, about 90% of total FDI inflows went to only five regions representing 59% of Italy's GDP (Lombardy, Piedmont, Lazio, Veneto, and Emilia Romagna). About 94% of FDI outflows originated from the same regions. Alternative evidence on the importance of multinational enterprises supports this picture.[3]

[2] Own calculations based on data from the Italian Statistical Office (ISTAT).

[3] See Banca dati REPRINT, ICE-Politecnico di Milano, www.ice.it.

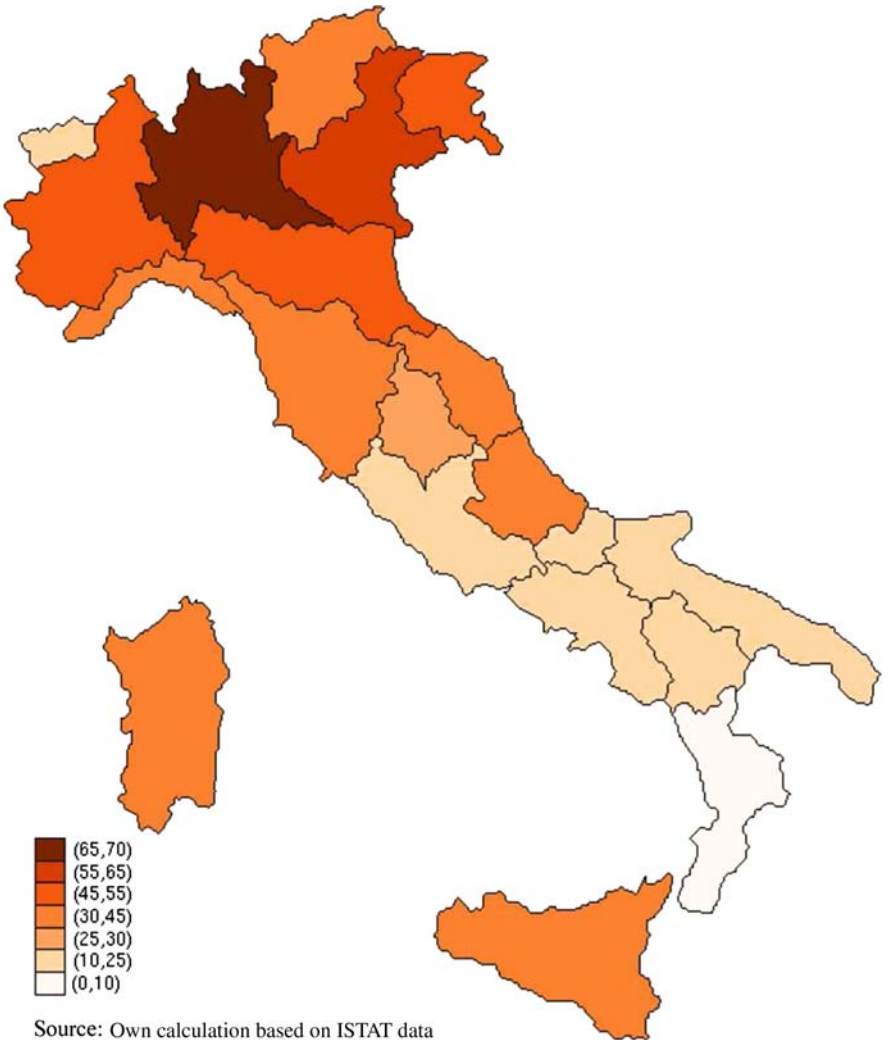

Fig. 1 Trade share of Italian regions in 2005 (% of GDP, at 2000 prices)

2.3 Migration

Data on migration flows and on the presence of foreigners in total population are further indicators of international integration. Generally, the Southern regions have not been very attractive destinations of migrants into Italy. This is likely to hold even if one acknowledges that illegal immigration is a more important phenomenon in the South than in the Centre-North. In 1993, the share of foreigners in total population was, on average, around 0.8% in the South, as compared to 2% in Italy as a whole. In 2005, the share was respectively, 1.5 and 4.2% for the South and Italy as a whole; in regions like Lombardy, Veneto, Emilia Romagna and Umbria, the value

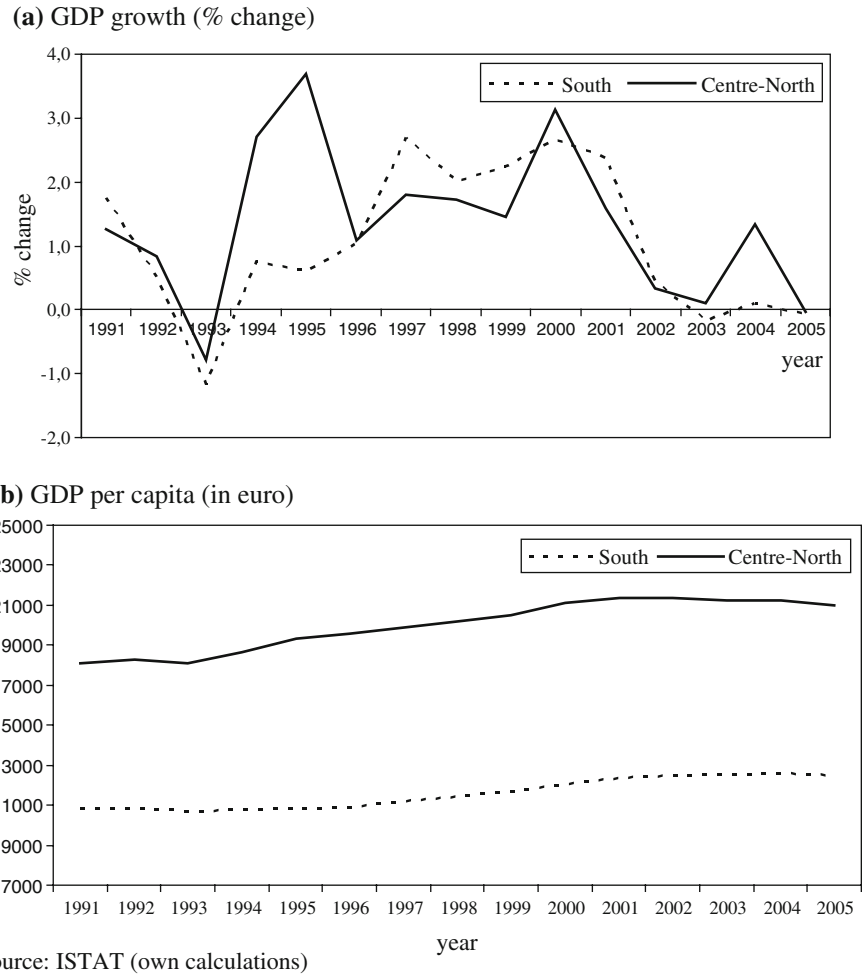

Fig. 2 GDP growth and GDP per capita at constant prices. GDP data for the 1991–2001 period refer to GDP at 1995 prices; since 2002 GDP at 2000 prices and chain indexes

ranged between 6 and 6.5%. Over the last 15 years, most Southern regions (in particular Campania, Molise, Puglia, Basilicata and Calabria) have constantly recorded net migration outflows (mainly migrations to other Italian regions) in the range of 0.2–0.5% of their population.[4]

2.4 Macroeconomic convergence

As far as the growth performance is concerned, the Centre-Northern regions have, on average, recorded a slightly better performance than those in the South (Fig. 2a). Persistence of differences in labor market performance has been another

[4] Figures in this section are computed from ISTAT data.

characteristic of the (lack of) macroeconomic convergence. Unemployment has been above average in the South. As for the rest of the country, there has been a trend decline in recent years.

The gap between the Centre-North and the South in income per capita has been equally persistent (Fig. 2b). After having widened significantly between 1991 and 1995, the gap has fluctuated around a year average of about 8,700€ in constant prices, while, in nominal terms, it has continued to grow. Nevertheless, measures of β and σ convergence over the whole 1991–2005 period signal a slow tendency towards convergence.

3 Openness and growth at the regional level

Northern and Southern Italy differ quite considerably in terms of openness for trade, capital flows, and migration—and income differentials between the two regions have been quite persistent. Are these observations linked? Assessing the impact of openness on growth or income per capita is complicated by the fact that trade might be endogenous to income. Regions that trade more might enjoy higher incomes—but they may also trade more precisely because their incomes are higher.

We use two methods to empirically study the link between openness and growth. The first is an IV estimator proposed by Frankel and Romer (1999). The second are panel cointegration techniques which account for regressor endogeneity (Sect. 4).

3.1 IV methods

Frankel and Romer (1999) propose using the geographic component in bilateral trade obtained from gravity regressions as a proxy for total trade. Yet, the original version of the model is not applicable to a panel context since the geographic component of trade does not vary over time. Still, we present results using the methodology of Frankel and Romer (1999) for two reasons. First, it provides us with an estimate of the determinants of trade in a bilateral setting and allows analyzing differences in openness between Southern and Northern Italy more systematically. Second, the model gives us a benchmark for comparing results of panel cointegration techniques. In a regional context, we can also use foreign GDP as a time-varying exogenous determinant of bilateral openness. The underlying assumption is that none of the Italian regions is large enough to affect foreign GDP through changes in bilateral openness.

The method requires a two-step estimation procedure. In a first step, a bilateral openness equation is specified. Predicted bilateral openness measures from this equation are then aggregated to obtain a measure of openness that is related to a set of exogenous variables only. In a second step, predicted aggregated openness is used as an instrument in a regression explaining the impact of openness on GDP per capita.

In Frankel and Romer (1999), the following gravity equation serves as the basis for constructing an instrument for the foreign trade share that is related only to exogenous geographic variables:

$$\tau_{ijt} = a_0 + a_1 X_{ij} + a_2 X_{it} + a_3 X_{jt} + a_4 S + \varepsilon_{ijt} \quad (1)$$

where τ_{ijt} is a measure of bilateral trade in logs, X_{ij} is a set of time-invariant bilateral explanatory variables (log of distance, common border, log of area, dummy variable for landlocked regions), X_{it} is a set of time-varying explanatory variables for the Italian region i (log of population), and X_{jt} is a corresponding set of explanatory variables for the foreign country j. Adding a dummy (S) which equals one for the Southern Italian regions, we can also test whether Southern Italy is significantly less integrated internationally than the rest of the country, as the descriptive statistics suggest.

Re-writing (1) in matrix form $\tau_{ijt} = \mathbf{a}'\mathbf{X}_{ijt} + \varepsilon_{ijt}s$, where $\mathbf{a}$ is the vector of coefficients and $\mathbf{X}_{ijt}$ is the vector of right-hand-side variables, gives region i's overall predicted trade as:

$$\hat{\Gamma}_{it} = \sum_{j \neq i} e^{\hat{\mathbf{a}}\mathbf{X}_{ijt}}. \quad (2)$$

The explanatory variables included in (1) are exogenous to economic growth of region i. This implies that, if predicted trade and actual trade are sufficiently correlated, predicted trade can be used as an instrument in a growth regression (see Sect. 3.3).

3.2 Gravity regressions and the determinants of openness

What explains the differences in openness across Italian regions reported above? To answer this question, we estimate gravity regressions for a region–country panel data set for Italy for the years 1991–2004 based on Eq. 1. We have a panel ($N \times T$) data set with N large (over 34,000 observations) and $T = 14$. We use the trade share (exports plus imports over GDP in natural logs) as well as imports and exports separately as dependent variables. The following explanatory variables are used (data definitions are given in the Appendix):

- *Geographic distance*: The expected effect is negative since transportation and communication costs increase the costs of trade over longer distances.
- *Population*: We expect a positive impact of population size in the home region and in the partner country, which proxies for market size.
- *Partner country GDP*: Partner country GDP is included as an additional measure of market size for the partner country. Also, foreign GDP has the advantage of being practically exogenous to a region's bilateral trade.[5] Hence, it can serve as a time-varying instrument for trade. The expected impact is positive since this variable measures external demand facing a region's exports.
- *Area*: The expected impact of the geographic area on the domestic region and the foreign partner country is negative as, in larger regions and countries, the intensity of intraregional interactions increases.

[5] We eliminate observations in which the share of bilateral imports or exports relative to partner country GDP exceeds 10%. These are less than 20 observations.

- *Landlocked*: A 0/1 dummy for Italian region and partner country being landlocked is included to capture the fact that landlocked regions typically trade less. The expected sign is negative.
- *Border effects*: Border effects are included in different ways. First, we use a 0/1 dummy for regions with an external border. We consider regions facing the sea as having an external border. Second, we use a 0/1 dummy for regions and partner countries sharing a common border. For both dummies, we expect a positive effect.
- *Mezzogiorno effects*: We test whether Southern Italian regions are less integrated into international trade by including a 0/1 dummy, and we estimate our model separately for the Centre-North and the South of Italy.

Table 2 reports the results and has four main findings:

First, for the pooled data set, the openness equation explains 75% of the cross-sectional variation in bilateral trade shares. The explanatory power is somewhat higher for the panel including only regions of the Centre-North (R^2 of 0.8) than for the South (0.67).

Second, most of the coefficient estimates are consistent across specifications and have to a large extent the expected signs. They are also in line with results reported in Frankel and Romer (1999). The distance coefficient for the trade share for the Centre-North (−0.84) is very close to the results obtained by Frankel and Romer (1999) for the world (−0.85). It is higher in absolute terms for the South (−1.20). Both, a region's population and area have a significant positive signs; corresponding size measures for partner countries are insignificant. Their effect is probably taken up mainly by partner countries' GDP (elasticity of 1.02).

Third, border effects are not estimated with a great degree of precision for the total trade share in the pooled model because border effects matter for the Centre-North only. The landlock dummy is insignificant for total trade or the import share, while it has the expected negative sign for exports. For exports, having an external border even has a negative effect. In unreported regressions excluding region fixed effects, we find coefficient estimates for the border effects that are more in line with expectations.

Fourth, in addition to the negative effect of distance being stronger for the South, belonging to the South has a negative level effect on trade and export shares. An alternative way of assessing differences in trade openness between Southern regions and the rest of the country is to estimate the openness regression excluding the South dummy and looking at the predicted trade shares from these regressions. We consistently find predicted trade shares that are larger than actual trade shares for the Southern Italian regions and predicted trade shares that are lower than actual trade shares of the Northern Italian regions. Hence, there are systematic differences between Centre-North and South in trade patterns, which are not explained by standard gravity variables.

We compute our predicted trade shares using two specifications for the dummy variables. The first specification includes time-varying partner country fixed effects in addition to the gravity variables used before. This addresses the fact that omitted variables in gravity regressions which are correlated with trade costs might be

Table 2 The openness equation

	Ln trade share			Ln export share			Ln import share		
	Total sample	South	Centre-North	Total sample	South	Centre-North	Total sample	South	Centre-North
Ln distance	−0.97*** (16.03)	−1.20*** (15.55)	−0.84*** (14.25)	−1.02*** (17.00)	−1.26*** (15.68)	−0.88*** (15.89)	−1.00*** (13.39)	−1.12*** (13.92)	−0.92*** (10.65)
Ln region's population	1.91*** (2.64)	3.44 (1.49)	2.95*** (4.18)	2.79*** (4.15)	2.96 (1.21)	4.82*** (6.78)	0.68 (0.69)	−0.16 (0.05)	1.09 (1.01)
Ln partner's population	−0.08 (1.31)	−0.11 (1.45)	−0.06 (1.11)	−0.15** (2.32)	−0.18** (2.15)	−0.14** (2.29)	0.11 (1.42)	0.03 (0.39)	0.15* (1.78)
Ln region's area	−2.95* (1.87)	−7.73 (1.31)	−5.23*** (3.39)	−4.82*** (3.28)	−3.04 (1.30)	−9.25*** (5.97)	−0.57 (0.26)	0.48 (0.16)	−1.44 (0.62)
Ln partner's area	0.02 (0.30)	0.08 (1.15)	−0.02 (0.47)	−0.05 (0.94)	−0.02 (0.23)	−0.06 (1.45)	0.07 (1.27)	0.15*** (2.87)	0.03 (0.43)
Ln GDP partner, co.p.	1.02*** (27.88)	1.03*** (22.82)	1.02*** (27.74)	1.07*** (28.51)	1.10*** (23.78)	1.07*** (28.11)	0.93*** (19.38)	0.89*** (17.48)	0.96*** (18.09)
Both landlocked (1/0)	−0.24 (1.37)		−0.19 (1.10)	−0.44*** (2.88)		−0.39** (2.55)	−0.08 (0.30)		0.01 (0.03)
Region with external border (1/0)	−0.15 (1.23)		−0.29** (2.27)	−0.29** (2.51)		−0.55*** (4.53)	0.3 (1.45)		−0.61 (0.65)
Common border region and partner (1/0)	0.26 (0.98)		0.56** (2.13)	0.17 (0.76)		0.50** (2.32)	0.62 (1.55)		0.70* (1.68)
Southern Italy (1/0)	−1.84*** (3.25)			−2.77*** (5.13)			−0.28 (0.16)		
Constant	−5.13 (1.11)	15.83 (0.78)	0.36 (0.08)	0.71 (0.17)	−16.12 (1.42)	12.07*** (2.75)	−13.69** (2.23)	−10.49 (0.73)	−11.63 (1.55)

Table 2 continued

	Ln trade share			Ln export share			Ln import share		
	Total sample	South	Centre-North	Total sample	South	Centre-North	Total sample	South	Centre-North
Observations	34146	13049	21097	33100	12241	20859	30441	10987	19454
R^2	0.75	0.67	0.8	0.76	0.68	0.82	0.61	0.54	0.64
Time and region dummies included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Trade is the sum of exports and imports. Estimation results are based on Eq. 1 using pooled OLS regression, standard errors which have been corrected for autocorrelation and heteroskedasticity and clustering observations by partner countries. Robust *t*-statistics are reported in brackets

***, **, * denote significance at the level of 1, 5 and 10%, respectively

correlated with the error term (Baldwin and Taglioni 2006). To account for the resulting omitted variable bias, Anderson and van Wincoop (2003) suggest including time-varying country fixed effects that capture so-called 'multilateral resistance'. Using this specification, the correlation between the actual level of the openness variables and the predicted values of trade, export and import shares is acceptable (0.4–0.5, see Table 3). The second specification includes time-varying partner country as well as regional dummies. Using this specification, we obtain predicted trade shares which have an even higher correlation with actual trade shares. However, it could be objected that the regional dummies are not fully exogenous, and we thus use this specification only to check the robustness of our results. In unreported regressions, we find that our main qualitative results are unaffected.

3.3 Openness and growth: IV regression results

With a proxy for predicted aggregated openness at hand, the baseline growth equation is specified as in Frankel and Romer (1999):

$$\ln\left(\frac{Y}{L}\right)_{it} = a + b\Gamma_{it} + c_1 \ln L_{it} + c_2 \ln K_{it} + c_3 S^{91-95} + c_4 T + u_{it} \qquad (3)$$

where $\left(Y/L\right)_{it}$ is income per capita in region I in year t, Γ_i is the actual volume of trade, and L_{it} is a region's population. We enrich the baseline growth equation of Frankel and Romer (1999) by adding the region's capital stock (K_{it}) and a linear time trend (T). To capture long-term income differentials between Centre-Northern and Southern regions, we also add a 0/1 South dummy and a 0/1 South dummy for the 1991–1995 period ($S^{91\text{-}95}$). After the 1992 currency crisis in the European

Table 3 Correlation between openness indicators and predicted values for trade

	Predicted shares		
	Trade share	Export share	Import share
Actual shares			
Trade share	0.4521***	0.4029***	0.4815***
Export share	0.4231***	0.4061***	0.4011***
Import share	0.4130***	0.3304***	0.5042***
FDI share	0.3321***	0.3191***	0.3066***
Migration share	0.3191***	0.4322***	0.1664***
Predicted shares			
Trade share	1.00		
Export share	0.9778***	1.00	
Import share	0.9449***	0.8587***	1.00

This table presents correlation coefficient between actual and predicted trade shares. The predicted trade shares are obtained from a regression using a full set of partner country × year dummy variables, as explained in the text

***, **, * denote significance at the level of 1, 5 and 10%, respectively

Monetary System and up to the mid-1990s, Southern Italy experienced a banking crisis, and investment subsidies were phased out.[6]

We estimate Eq. 3 by using IV techniques with $\hat{\Gamma}_{it}$ serving as an instrument for Γ_{it}. The set of instruments includes the IV variables for trade, imports or exports, and time-varying 0/1 Southern dummies. These account for differences in the determinants of trade between Southern Italy and the rest of the country. We use IV fixed-effects panel regressions with robust standard errors accounting for arbitrary heteroscedasticity and autocorrelation in residuals. Our central assumption is that the openness instrument $\hat{\Gamma}$ is exogenous and can be expressed as $E(\hat{\Gamma}_i u_i) = 0$. We therefore check the IV regression results by looking at first-stage small sample statistics and at specification tests of underidentification (Anderson canonical correlation), weak identification (Cragg–Donald χ^2 robust), weak-instrument robust inference (Stock–Wright S, Anderson–Rubin F, Anderson–Rubin χ^2) and, when using more that one instrument, the Hansen J statistic for overidentification (level and p-values).

We use GDP per capita as the dependent variable to estimate the effect of trade on income because the neoclassical growth model predicts a one-time shift in income following international integration rather than a permanent growth effect (Henry 2007). Table 4 presents different specifications for our growth equations using trade (the sum of exports and imports), exports and imports separately, and including/excluding a linear time trend. The dependent variable is the natural log of regional income per person at constant prices.[7]

The regression results depend on the fact whether a time trend is included or not. If a time trend is not included, trade, exports, and imports have a positive and highly significant impact on GDP per capita. Furthermore, we cannot reject the hypothesis that predicted trade shares are valid instruments for actual trade.

However, the model does not pass the specification tests when a time trend is included. The trend term is significant and positive, and total trade as well as exports becomes insignificant. The positive coefficient on the import shares remains significant but declines in magnitude. These results could be taken as evidence that trade and exports merely pick up a time trend. However, when including a linear time trend, the model does not pass the Hansen J over-identification test. Similarly, some models including a time trend do not pass the underidentification and weak identification tests (Anderson canonical correlation and the Cragg–Donald χ^2) or the Stock–Wright test.

In unreported regressions, we have also checked the robustness of our results with regard to measures of human capital (average years of schooling) and the state of technology (research and development expenditures). These specifications do not pass our specification tests, but the qualitative results concerning the impact of trade remain unaffected.

[6] See, e.g., Bank of Italy, *Relazione Annuale*, various issues, in particular those on 1994, 1995 and 1996.

[7] Unreported results using the capital stock per employee rather than the total capital stock are very similar.

Table 4 GDP per capita and openness

	(1)	(2)	(3)	(4)	(5)	(6)
Ln trade share	0.011 (0.018)	0.217*** (0.025)				
Ln export share			0.007 (0.015)	0.149*** (0.022)		
Ln import share					0.046** (0.018)	0.256*** (0.031)
Ln region's population	−1.168*** (0.139)	−0.616** (0.301)	−1.223*** (0.143)	−0.523 (0.368)	−1.177*** (0.134)	−0.778*** (0.250)
Ln capital stock	0.096*** (0.020)	0.259*** (0.032)	0.095*** (0.019)	0.362*** (0.030)	0.082*** (0.021)	0.233*** (0.034)
South 1991–1995	−0.008* (0.004)	−0.033*** (0.005)	−0.008* (0.004)	−0.041*** (0.006)	−0.006 (0.004)	−0.044*** (0.007)
Trend	0.014*** (0.001)		0.015*** (0.001)		0.014*** (0.001)	
Observations	271	271	261	261	267	267
R^2	0.902	0.685	0.902	0.651	0.905	0.666
1st stage *F*-statistics	5.56***	9.44***	15.62***	19.28***	7.71***	10.94***
Stock–Wright *S*, *p*-value	0.27	0.10	0.33	0.11	0.35	0.09
Anderson canonical correlation LR, *p*-value	0.00	0.00	0.00	0.00	0.00	0.00
Cragg–Donald robust χ^2, *p*-value	0.00	0.00	0.00	0.00	0.00	0.00
Anderson–Rubin χ^2, *p*-value	0.00	0.00	0.00	0.00	0.00	0.00
Anderson–Rubin *F*, *p*-value	0.00	0.00	0.00	0.00	0.00	0.00
Hansen overidentification test	15.50	10.79	14.80	12.44	12.70	11.35
(*p*-value)	0.22	0.55	0.25	0.41	0.39	0.50

This table reports the results of fixed effects IV regressions, using predicted trade shares as instrument of actual trade. The dependent variable is the natural log of real GDP per capita. Trend is a linear time trend, South is 0/1 dummy for Southern regions, South 1991–1995 is an interaction term between a 0/1 dummy for Southern regions and the pre-1996 period

***, **, * denote significance at the level of 1, 5 and 10%, respectively

Results excluding a time trend indicate quite robustly that more trade is associated with higher GDP per capita. Regions endowed with a higher capital stock also have a higher GDP per capita. The impact of population size is not statistically different from zero, while the fact of being located in the South has a negative impact on GDP per capita during the first half of the 1990s. These results are in line with those of Frankel and Romer (1999). In their baseline model, they find a positive impact of trade on GDP per capita, a negative impact of country size (area), and a positive

impact of population size. In unreported regressions, we use pooled ordinary least squares (OLS) regressions. Consistent with Frankel and Romer (1999), we find that the IV coefficient estimates of the openness measures exceed the OLS estimates.

3.4 Intranational versus international trade

The fact that each Italian region not only trades with the rest of the world but also with other Italian regions could imply an omitted variables bias in our estimates.[8] To account for this, we use a measure of the volume of intraregional goods being transported on roads, which is provided by the Italian Statistical Office ISTAT (Istituto Nazionale di Statistica). This is not a perfect but a reasonably close proxy for total intranational trade as it is highly correlated with total domestic trade. With the volume data at hand, we compute a set of statistics measuring the value of intraregional goods being transported on roads. Following a method similar to Helble (2007), we multiply the volume data by the average unit value of region's exports to the European Union. This can be considered as a proxy for the average unit value of the intra-national trade flows. The intranational trade data for road transport are available for the years 1998–2005.

With these data at hand, we essentially follow the same strategy as before. We estimate a gravity equation for intranational trade, which gives very reasonable results, i.e. distance has a negative impact (−1.56), and population (+0.91) and common border (+0.57) have a positive impact. From these gravity equations, we generate predicted intranational trade as an instrument for actual intranational trade, following Frankel and Romer (1999).

With the instruments for intranational trade, we re-estimate our growth regressions for the panel of Italian states. Including intranational trade (exports) does not affect our main conclusions.[9] The export share has a positive and significant impact on GDP per capita throughout, and it is not affected by the inclusion of proxies for intranational trade or a time trend or different instruments. Generally, due to the relatively short time series of the panel, results for regressions including intranational trade are less strong as those for the full sample. The significance of population and the capital stock, for instance, depends on including a trend, and the Hansen test gives less strong results.

4 Trade and GDP per capita in the long run: Panel cointegration

Results in the previous section provide evidence for a positive impact of trade on GDP per capita. Taken together with the results from the gravity regressions—that being located in Southern Italy has a negative impact on trade shares—this indicates that a lower degree of trade openness is one reason for the persistent differences in GDP per capita across Italian regions. However, the above results are sensitive to including a time trend, which might suggest that the link between trade and GDP per

[8] We owe this point to an anonymous referee.

[9] These results are not reported but available upon request.

Table 5 Panel unit root tests

Variable	Levin et al. (2002)	Im et al. (2003)	Breitung and Das (2005)
Levels			
Ln GDP per capita	−0.69	1.76	2.11
Ln trade share	−3.84***	0.64	0.98
Ln import share	−6.81***	−1.87**	−1.71*
Ln export share	−4.51***	−0.42	2.08
Ln population	7.43	10.47	7.13
Ln capital stock	−6.60***	−2.90***	−1.08
First differences			
Ln GDP per capita	−12.23***	−5.20***	−4.92***
Ln trade share	−13.43***	−8.01***	−8.73***
Ln import share	−13.98***	−8.02***	−9.31***
Ln export share	−12.24***	−8.34***	−7.77***
Ln population	8.67	9.11	10.02
Ln capital stock	−12.65***	−5.48***	−7.66***

This table reports the test statistics of panel unit root tests based on Levin et al. (2002), Im et al. (2003), and Breitung and Das (2005). The tests are based on a maximum number of observations $N \times T = 260$, $N = 20$. The null-hypothesis is that the series contains a unit root. The maximum lag length was set at eight quarters, basing the automatic lag selection on the SIC criterion. Newey–West bandwidth selection uses a Bartlett kernel. All variables are in logs

***, **, * denote significance at the level of 1, 5 and 10%, respectively

capita is spurious. In this section, we test whether there is a long-run cointegration relationship between trade and GDP per capita.

Our growth model is a fairly typical macro-panel with a similar dimension of the cross-section ($N = 20$) and the time series ($T = 14$). Ignoring nonstationarity may thus lead to spurious regressions, as in time series data. Results of panel unit tests provide consistent results for GDP per capita to be nonstationary (Table 5). For other variables, the results are less clear cut and depend on the specific unit root test chosen. For the main variable of interest, the trade share, the tests by Im et al. (2003) and Breitung and Das (2005) indicate that this variable is nonstationary. This nonstationarity is driven by the export share whereas the import share seems to be stationary. For the remaining control variables, the tests yield different results, indicating nonstationarity of population and stationarity of the capital stock. Still, the nonstationary variables can be included since they should have an impact on GDP per capita.

Since our main interest is in the long-run effects of trade openness on income per capita, we estimate a cointegrated panel model. The cointegration tests require a balanced panel, and we include only the key explanatory variables of interest (trade, capital stock, population) as time series for the remaining variables are partly incomplete. In Table 7, we present estimates for the long-run cointegration coefficients using three different specifications: a fully modified OLS regression

Table 6 Panel cointegration tests

	Trade	Imports	Exports	Imports and exports
DF_ρ	−2.35***	−3.55***	−1.81**	−2.83***
DF_t	−2.00**	−2.90***	−1.51*	−2.34***
DF_ρ*	−7.74***	−9.58***	−6.87***	−8.23***
DF_t*	−3.25***	−3.93***	−2.88***	−3.50***
$t^{\rho NT}$	−159.31***	−169.08***	−150.24***	−160.77***
$t_{N1\rho}$	−16.86***	−17.42***	−16.60***	−17.30***
$t_{N2\rho}$	−16.24***	−16.79***	−15.99***	−16.67***

This table presents results of the panel cointegration tests proposed by Kao (1999) and Pedroni (2000). Kao's (1999) tests DF_ρ and DF_t are based on the assumption of strong exogeneity of the regressors and errors; DF_ρ^* and DF_t^* are based on the assumption of endogeneity of regressors and errors. The H_0 hypothesis is 'no cointegration'. Pedroni's tests allow for heterogeneity in the cointegration relationships and are based on the H_0 of no cointegration as well. In addition to the different trade measures, the regression equations include population and capital stock

***, **, * denote significance at the level of 1, 5 and 10%, respectively

(FMOLS), a dynamic OLS regression (DOLS), and the two-step estimator proposed in Breitung (2005).[10] Table 6 provides the results of cointegration tests. These support the presence of cointegration relationships among the variables of interest.

These cointegration estimators have two advantages over the IV estimates reported above. First, they account for the possibility that the link between trade and growth could be spurious by explicitly testing for the presence of cointegration relationships. Second, they address the problem of regressor endogeneity without having to rely on predicted values obtained from gravity regressions.[11] The FMOLS estimator corrects the OLS estimator nonparametrically for serial correlation and regressor endogeneity by adjusting the dependent variable for the part of the error that is correlated with the regressor. The DOLS estimator uses information from past and future leads and lags of all variables. The two-step estimator proposed by Breitung (2005) performs a correction for endogeneity at the second stage as well. Using a two-step FMOLS procedure, common factors are estimated from the residuals of an initial FMOLS estimation. Moreover, Breitung (2005) shows that this estimator creates a smaller estimation bias in small samples such as ours compared to the DOLS and the FMOLS estimator. The single equation estimators (FMOLS and DOLS) also have the drawback that they assume all regressor to be I(1) and not to be cointegrated. Yet, these drawbacks can be avoided by using a system approach such as the two-step estimator proposed by Breitung (2005).[12] This estimator does not impose the assumption that there is only one cointegration vector.

[10] See also Breitung and Pesaran (2008).

[11] Note that our model is a reduced-form estimate of the impact of trade on GDP per capita. Therefore, we do not account for the possibility of reverse causality running from GDP per capita to trade.

[12] See Breitung and Pesaran (2008) for details.

Table 7 Long-run cointegration coefficients

(a) Trade share/import share

	FMOLS (1)	DOLS (2)	Two-step (3)	FMOLS (4)	DOLS (5)	Two-step (6)
Ln trade share	0.20*** (11.23)	0.21*** (10.22)	0.18*** (16.71)			
Ln import share				0.23*** (10.69)	0.22*** (8.71)	0.22*** (16.07)
Ln population	−0.76*** (−2.59)	−0.83*** (−2.42)	−1.23*** (−5.49)	−1.03*** (−3.48)	−1.02*** (−2.90)	−1.23*** (−5.39)
Ln capital stock	0.30*** (8.00)	0.29*** (6.53)	0.25*** (9.25)	0.30*** (7.74)	0.23*** (5.00)	0.22*** (7.78)
Number of groups	20	20	20	20	20	20
Observations	284	284	284	284	284	284
R^2	0.64	0.70		0.62	0.67	

(b) Export share/import plus export share

	FMOLS (1)	DOLS (2)	Two-step (3)	FMOLS (4)	DOLS (5)	Two-step (6)
Ln import share				0.10*** (3.75)	0.13*** (4.06)	0.14*** (7.02)
Ln export share	0.16*** (10.76)	0.18*** (9.98)	0.15*** (14.39)	0.10*** (5.55)	0.10*** (4.61)	0.07*** (5.03)
Ln population	−0.68*** (−2.22)	−0.89*** (−2.44)	−1.28*** (−5.38)	−0.79*** (−2.84)	−0.95*** (−2.90)	−1.17*** (−5.49)
Ln capital stock	0.32*** (8.33)	0.34*** (7.38)	0.29*** (10.36)	0.29*** (7.97)	0.26*** (5.98)	0.23*** (8.41)
Number of groups	20	20	20	20	20	20
Observations	284	284	284	284	284	284
R^2	0.61	0.67		0.66	0.71	

These tables present estimates for the long-run cointegration parameters using a fully modified OLS estimator (FMOLS), a dynamic OLS estimator (DOLS), and the two-step estimator proposed by Breitung (2005). All estimates presented are for the years 1991–2003 and are based on a sample with $N = 21$ and $T = 13$

***, **, * denote significance at the level of 1, 5 and 10%, respectively

More specifically, the two-step estimator is based on the following general representation of a cointegrated VAR(p):

$$\Delta y_{i,t} = \psi_i d_t + \alpha_i \beta' y_{i,t-1} + \sum_{m=1}^{p-1} \Phi_{i,m} \Delta y_{i,t-m} + \varepsilon_{i,t} \tag{4}$$

where $\varepsilon_{i,t}$ is an error term with $E(\varepsilon_{i,t}) = 0$, $\Sigma_i = E(\varepsilon_{i,t}\varepsilon'_{i,t})$, d_t is a vector of deterministic variables, ψ_i is a coefficient matrix, and $y_{i,t}$ is the vector of variables including trade, GDP per capita, population, and the capital stock. As before, we also split up total trade into exports and imports. The interpretation of this equation

is that changes in y in each region i and each year t are driven by the long-run error correction term $\beta' y_{i,t-1}$, the loading coefficient α_i, and the short-run dynamics $\sum_{m=1}^{p-1} \Phi_{i,m} \Delta y_{i,t-m}$.

We are interested in the long-run cointegration vector β. It is assumed to be homogenous across regions. Within a given country, this assumption is reasonable, since it essentially implies the use of the same production technology. The speed of adjustment to the steady state α_i is allowed to differ across regions. $\Phi_{i,m}$ is a vector of coefficient estimates indicating the short-run adjustment, and it is assumed to be heterogeneous.

Estimates of the long-run cointegration vectors show that higher trade, a higher capital stock, and a smaller population increase GDP per capita (Table 7). All coefficients are highly significant. The estimated elasticities are plausible: a 1% increase in trade or in the capital stock increases income per capita by about 0.20%. These estimates are very close to those obtained using the methodology of Frankel and Romer (point estimate of 0.22, see Table 4). Breaking up total trade (exports plus imports) into export and import shares gives very similar results. The corresponding coefficients for the import and export shares are 0.22 and 0.16, which are again close to the results using the IV estimation methodology described above. The elasticity with regard to population size varies between 0.7 and 1.3 and lies in a similar range as those obtained from the IV estimates.

Overall, results using the panel cointegration tests confirm evidence using IV techniques in terms of the magnitude of coefficient estimates and their significance. The point estimates are very similar across the different panel cointegration estimators used. This strengthens our confidence that the positive impact of trade on growth is not spurious but rather reflects long-run cointegration relationships in the data.

5 Summary and conclusions

In this paper, we have analyzed whether differences in income per capita between Southern Italy and the North-Centre regions—the "Mezzogiorno effect"—are due different degrees of international openness. According to measures of de facto openness, Southern Italian regions are less integrated internationally than the Centre-Northern ones. They trade less with the rest of the world, they host less foreign residents, and they are the destination and source of lower FDI flows than the Centre-Northern regions.

We have used two empirical models to assess the impact of trade on growth in the presence of endogenous regressors: an IV estimator and panel cointegration methods. From a methodological point of view, cointegration methods have the advantage of not relying on largely time-invariant instruments to account for the endogeneity of trade. Hence, they are more applicable in a panel context. Our paper has four main findings.

First, the openness equation performs quite well on Italian regional data. Regional geographic characteristics explain a significant share of the variance of regional external trade.

Second, Southern Italian regions trade significantly less than the Centre-Northern regions, and distance has a strong negative impact on Southern Italy's bilateral trade links. In this sense, geography explains a good deal of the higher degree of trade openness observed in the Centre-Northern regions.

Third, using predicted values for bilateral trade as a proxy for aggregated openness across regions, we find evidence for a positive link between trade openness and GDP per capita. This effect is significant even though we include other variables affecting growth such as the capital stock or the size of regions.

Fourth, we use panel cointegration tests to confirm that these results are not spurious. The coefficient estimate obtained for the trade variables are very similar to those obtained from the IV regressions.

Overall, our results provide robust evidence for Italy that higher trade and a higher capital stock increase GDP per capita. Increasing trade or the capital stock by 1% leads to an increase in income per capita by about 0.2 and 0.3%, respectively. From a methodological point of view, the use of panel cointegration models seems a fruitful avenue for future research in similar applications using country level data. Panel cointegration models account for common trends in the data and address issues of endogeneity without requiring time-varying instruments for trade.

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Appendix

Data definitions and sources

Area: Area in Km^2. Sources: ISTAT for Italian regions, World Bank (2008) for foreign partner countries.

Capital stock: The regional capital stock is computed on the basis of the total capital stock for Italy (at 2000 prices) as published by ISTAT (2006); the annual regional real investment share of total national real investment (source: ISTAT, *Conti economicici regionali*) is used as a proxy to allocate regionally the national capital stock.

Centre-North: Italian regions including: Piemonte, Valle d'Aosta, Lombardia, Trentino-Alto Adige, Veneto, Friuli Venezia Giulia, Liguria, Emilia-Romagna, Toscana, Umbria, Marche, Lazio.

Distance: Approximate distance formula applied to the longitude and latitude of the main regional center and of country capitals, in km.

Foreign Direct Investment: The source of the inward and outward FDI flows is Banca d'Italia balance of payments data. Inward flows by region are total FDI flows that originate from partner country "world" and whose destination are enterprises resident in a given region. Similarly FDI outflows are flows originating from enterprises residing in a given region and whose destination is partner country "world". Regional flows do not sum up to total national flows due to the presence of transactions that could not be allocated regionally. The FDI share is computed as regional inflows plus outflows over regional GDP.

Foreign residents: The source of data on foreign residents by region is ISTAT, in particular the following publications: ISTAT (2000), ISTAT (2004) and http://demo.istat.it/. For the 1999–2002 period, data for total residents are own estimates based on data on "resident permits" published by ISTAT. The foreign residents' share is computed as a ratio between total foreign residents by region and regional population.

Foreign trade: Trade in goods (imports and exports) at current prices and exchange rates. Computations based on ISTAT data and taking into account only trade flows regionally allocated by ISTAT.

Human capital: The human capital stock (HC) is constructed following Bronzini and Piselli (2006). In particular, the HC variable for the years 1992–2005 is computed as the average number of years of schooling needed to reach a given qualification, weighted by the share (out of the total) of employees in each region having that qualification. The data source is ISTAT (2007). Qualification levels are transformed into years of schooling in the following way: 0 years of schooling for "no qualification", 5 for completing lower primary school, 8 for lower secondary school, 10.5 for a professional diploma, 12.5 for completing secondary education, 15.5 for a laurea breve (bachelor degree), 17.5 for a standard graduate degree, 21.5 for a "dottorato", PhD or other post-graduate degree. No data are available for Valle d'Aosta.

Migration flows: The source of internal and external migration flows is ISTAT's data on "bilancio demografico". The migration share is computed as a share of the balance of total registration minus total deregistrations over total regional population. A breakdown is also available for internal migrations (registrations from another region minus deregistration to move to another region for internal migrations and registration from abroad minus deregistrations abroad).

Population: ISTAT's demography database (ISTAT, *Demo: demografia in cifre*) for the population of the Italian regions; World Bank (2008) for foreign partner countries.

Real and nominal GDP per capita: For the Italian regions: ratio between regional GDP (at current prices and, until 2001, at 1995 prices, since 2002 at 2000 prices and chain indexes) as published by ISTAT's regional accounts (ISTAT, *Conti economicici regionali*) and average annual regional population. For partner countries: World Bank (2008).

Research and development (R&D) capital stock: The R&D capital stock is computed according to Bronzini and Piselli (2006). Up to 2001 data are Bronzini and Piselli's ones. For the years 2002–2005, the R&D capital stock (SD&R) is computed from ISTAT's *La ricerca e sviluppo in Italia* in the following way: R&D expenditure (R_t) at current prices is first converted into constant (1995) prices, then the perpetual inventory method with a depreciation rate (δ) of 15% is applied to the 2001 capital stock, that is: $SD\&R_t = SD\&R_{t\_1}(1 - \delta) + R_t$, where $SD\&R_0 = SD\&R_{2001}$.

South: Italian regions including: Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, Sardegna

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